

Appl. No. 10/648,594
Amdt. Dated Feb. 10, 2005
Reply to Office Action of November 10, 2004

REMARKS

Claim Rejections - 35 USC §102

Claims 1-6 and 8 are rejected under 35 U.S.C. 102(e) as being anticipated by US/2004/0097635 to Fan et al., (Fan).

Regarding claim 1, applicant respectfully traverses the rejection for the following reasons:

Claim 1 of the present invention recites that a thermal interface material comprises: a polymer matrix having a thermally conductive first face and an opposite thermally conductive second face; and a plurality of carbon nanocapsules incorporated in the polymer matrix.

Comparing the thermal interface material of claim 1 with that of Fan, materials which are incorporated in the polymer matrix are different. The materials incorporated in the polymer matrix in claim 1 of the present invention are carbon nanocapsules. In contrast, the materials incorporated in the polymer matrix in Fan are carbon nanotubes. Fan clearly characterizes item 32 thereof as carbon nanotubes (para. [0025]), contrary to Examiner's characterization of the item as being carbon nanocapsules. A carbon nanocapsule is different from a carbon nanotube. As stated in para. [0010] of the specification, carbon nanocapsules are polyhedral carbon clusters, which are formed by a carbon sphere encircling another sphere. Further, the word "capsule" includes the meaning of "a compact often sealed and detachable container or compartment" (Merriam-Webster's dictionary), and thus the expression "carbon nanocapsule" has a similar corresponding meaning. That is, a carbon nanocapsule is a nano-sized sealed and detachable container or

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compartment made from carbon. In contrast, one skilled in the art knows that “carbon nanotubes” have a hollow tubular structure. Therefore, the thermal interface material of claim 1 is different from the thermal interface material disclosed by Fan.

That is, Fan does not anticipate the above-described limitation in claim 1 of the present invention. Accordingly, reconsideration and withdrawal of the rejection and allowance of claim 1 over Fan are respectfully requested.

Claims 2-6 and 8 depend directly or indirectly from claim 1, and therefore should also be allowable over Fan.

Claims 1-6 and 8 are stated to be rejected under 35 U.S.C. 102(a)(e) as being anticipated by US/6,407,922 to Eckblad et al. (Eckblad).

Regarding claim 1, applicant respectfully traverses the rejection for the following reasons:

What Eckblad really discloses is a heat spreader including a matrix material which has incorporated therein carbon nanotubes and/or thermal pyrolytic graphite flakes. Eckblad clearly characterizes item 17 thereof as carbon nanotubes and/or thermal pyrolytic graphite flakes (col. 6, lines 14-17), contrary to Examiner's characterization of the item as being carbon nanocapsules.

For the similar reasons to those asserted above in relation to the rejection on Fan, applicant asserts that a carbon nanocapsule is different from a carbon nanotube. In addition, a carbon nanocapsule is different from a thermal pyrolytic

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graphite flake, if for no other reason because a capsule is not a flake. In summary, the carbon nanocapsules of claim 1 of the present invention are different from the carbon nanotubes or thermal pyrolytic graphite flakes of Eckblad. That is, the thermal interface material of claim 1 is different from the heat spreader disclosed by Eckblad.

Therefore, Eckblad does not anticipate the above-described limitation in claim 1 of the present invention. Accordingly, reconsideration and withdrawal of the rejection and allowance of claim 1 over Eckblad are respectfully requested.

Claims 2-6 and 8 depend directly or indirectly from claim 1, and therefore should also be allowable over Eckblad.

Claims 1-6 and 8 are rejected under 35 U.S.C. 102(e) as being anticipated by US/2004/0005736 to Searls et al. (Searls).

Regarding claim 1, applicant respectfully traverses the rejection for the following reasons:

What Searls really discloses is a thermal interface layer having carbon nanotubes mixed with a paste matrix. Searls clearly characterizes item 38 thereof as carbon nanotubes (para. [0015]), contrary to Examiner's characterization of the item as being carbon nanocapsules.

For the similar reasons to those asserted above in relation to the rejection on Fan, applicant asserts that a carbon nanocapsule is different from a carbon nanotube. That is, the thermal interface material in claim 1 of the present

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invention is different from the thermal interface layer of Searls.

Therefore, Searls does not anticipate the above-described limitation of claim 1 of the present invention. Accordingly, reconsideration and withdrawal of the rejection and allowance of claim 1 over Searls are respectfully requested.

Claims 2-6 and 8 depend directly or indirectly from claim 1, and therefore should also be allowable over Searls.

Claim Rejections - 35 USC §103

Claims 7 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Eckblad or Searls, each taken alone.

In response to the rejection, applicant has canceled claim 7, and added a new claim 20 that depends from claim 8. New claim 20 contains the subject matter of claim 7, and is believed to be allowable based on the above-asserted allowability of claim 8.

Further, regarding claim 9, applicant traverses the rejection for the following reasons:

First, the thermal interface material of claim 9 is different from either the heat spreader of Eckblad or the thermal interface layer of Searls. As asserted above, both Eckblad and Searls fail to disclose using carbon *nanocapsules* to incorporate in the polymer matrix of the thermal interface material in claim 9 as claimed in the present invention. In addition, both Eckblad and Searls fail to disclose or suggest

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the carbon nanotubes or the thermal pyrolytic graphite flakes in the heat spreader or thermal interface layer being enclosed with anything. The two references fall short of the present invention in which the carbon nanocapsules are enclosed with thermally conductive material.

Second, the differences between the thermal interface material of claim 9 of the present invention and the structures of the two references produce new and unexpected results, due to the carbon nanocapsules of the present invention being enclosed with thermally conductive material. Heat produced by electrical components is able to be absorbed into the thermally conductive material as well as the carbon nanocapsules themselves. Therefore the thermal interface material of claim 9 provides improved thermal conduction characteristics, for ensuring that semiconductor devices work under favorable temperature conditions with better performance and reliability.

For the above reasons, applicant asserts that claim 9 is unobvious and patentable over Eckblad or Searls under 35 U.S.C. 103.

Accordingly, reconsideration and withdrawal of the rejection and allowance of claim 9 are respectfully requested.

In view of the foregoing, the present application as claimed in the pending claims is considered to be in a condition for allowance, and an action to such effect is earnestly solicited.

Respectfully submitted,

Ga-Lane Chen et al.

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By


Wei Te Chung

Registration No.: 43,325

Foxconn International, Inc.

P.O. Address: 1650 Memorex Drive, Santa Clara, CA 95050

Tel. No.: (408) 919-6137